



Preliminary

GRF2505

Linear PA Driver/Ultra-low Noise Amplifier; 4.0 - 6.0 GHz

Package: 1.5 x 1.5 mm DFN-6



Product Description

The GRF2505 is a broadband, ultra-low noise, linear amplifier offering the highest levels of performance for demanding 802.11ac and wireless backhaul LNA and PA driver applications. This amplifier exhibits outstanding broadband NF, linearity and return losses over 4.0 to 6.0 GHz with a single match. It is operated from a single positive supply of 1.8 V to 5.0 V with a selectable Iddq range of 20 to 70 mA for optimal efficiency and linearity.

GRF2505 is internally matched to 50 Ω at the input and output ports, requiring only 7 external RLC components.

Consult with the GRF applications engineering team for custom tuning/evaluation board data and device s-parameters.

Features

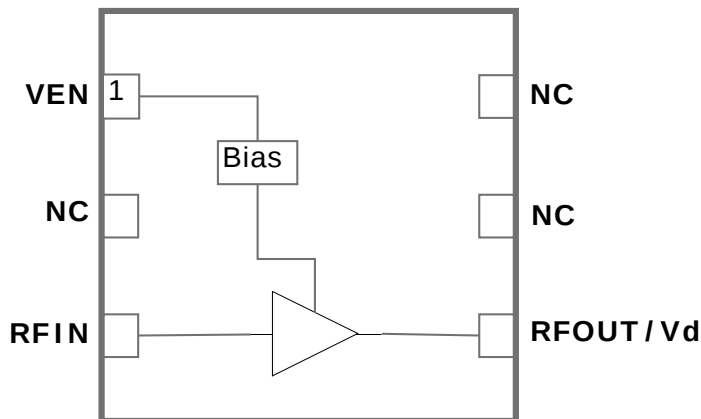
- Broadband: 4.0 GHz to 6.0 GHz
- 0.77 dB Noise Figure at 5.5 GHz
- Gain: 12.7 dB at 5.5 GHz
- OIP3: +32.0 dBm at 5.5 GHz
- OP1dB: +20.0 dBm at 5.5 GHz
- Flexible Bias Voltage and Current
- Internally Matched to 50 Ω
- Process: GaAs pHEMT

Applications

- PA Driver / Low Noise Amplifier for 5 GHz LTE Backhaul and 802.11a/n/ac
- Vehicle Information Systems
- Automated Toll Reader
- C-Band Amplifier

Functional Block Diagram

1.5 x 1.5 mm DFN-6



Absolute Ratings:

Parameter	Symbol	Min.	Max.	Unit
Drain Voltage	V _d	0	6.0	V
RF Input Power: (Load VSWR < 2:1; V _d : 5.0 volts)	P _{IN MAX}		+15	dBm
Operating Temperature	T _{AMB}	-40	+105	°C
Storage Temperature	T _{STG}	-40	+150	°C
Maximum Channel Temperature	T _{MAX}		+170	°C
Maximum Dissipated Power	P _{DISS MAX}		275	mW
Electrostatic Discharge:				
Charged Device Model: (TBD)	CDM	Class 4: 1000		V
Human Body Model: (TBD)	HBM	Class 1B: 500		V
Machine Model: (TBD)	MM	Class A: 50		V

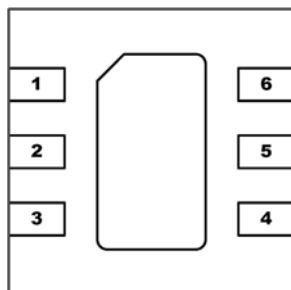


Caution! ESD Sensitive Device



Exceeding Absolute Maximum Rating conditions may cause permanent damage to the device.

Pin Out (Top View)

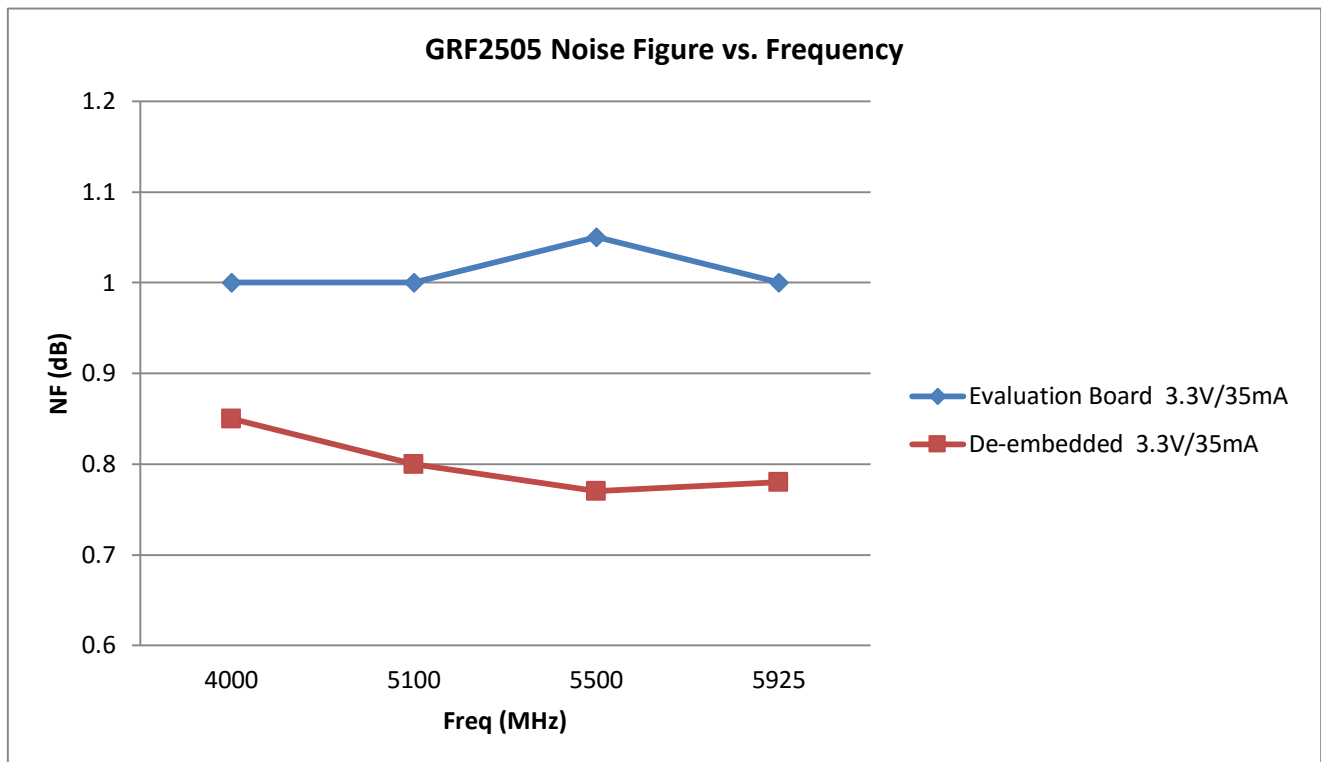
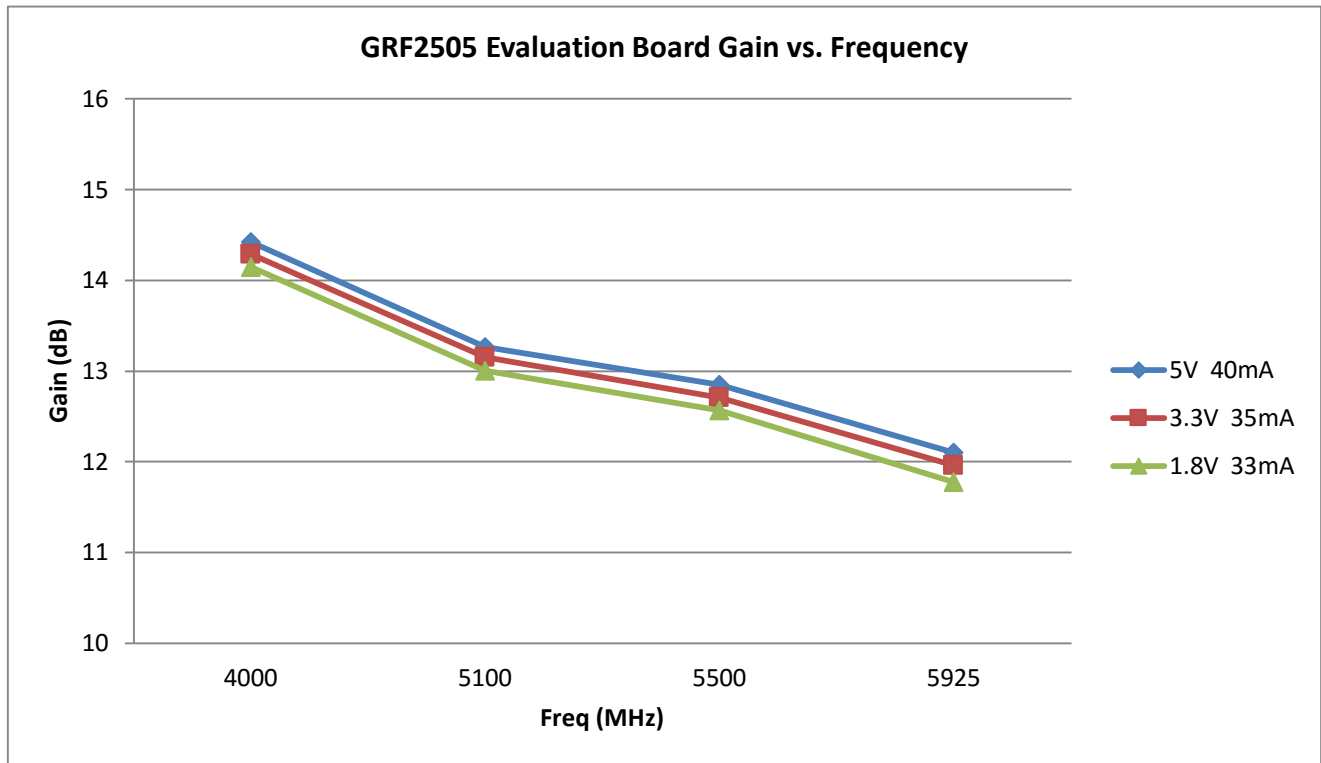


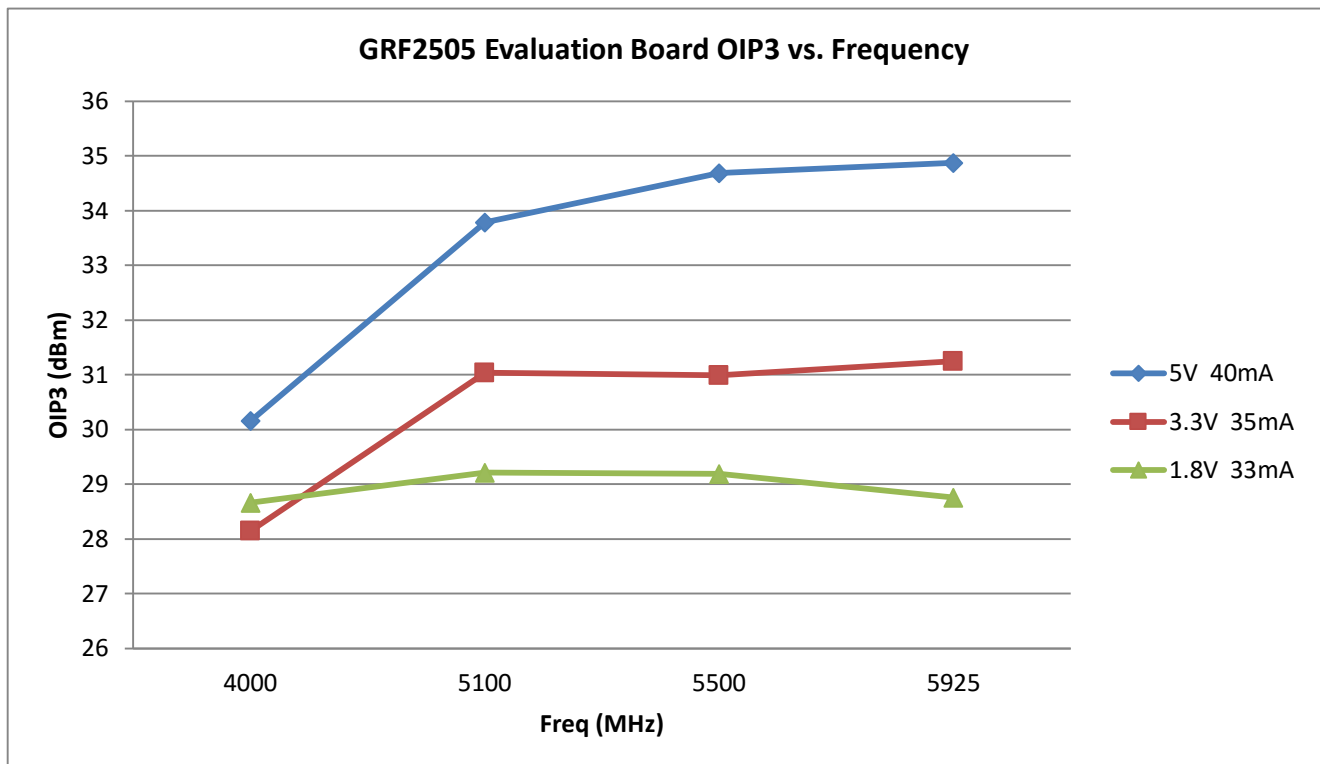
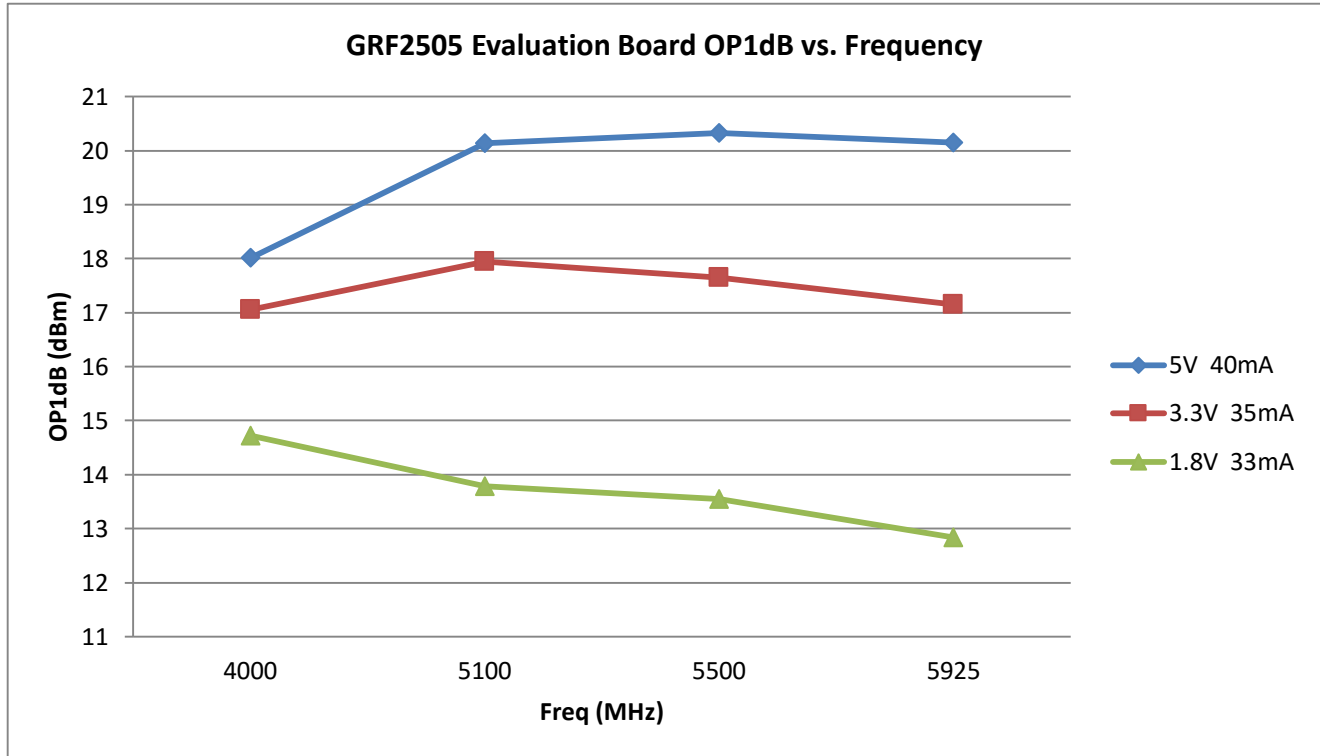
Pin Assignments:

Pin	Name	Description	Note
1	V_{ENABLE}	Enable Voltage Input	Venable < 0.2 volts turns the device off. Venable and series resistor M3 control the device Iddq.
2	NC	No Connect or Ground	No internal connection to die
3	RF_In	LNA RF input	Internally matched 50Ω. An external DC blocking cap must be used.
4	RF_Out	LNA RF output	Internally matched 50Ω. V _{DD} must be applied through a choke to this pin
5	NC	No Connect or Ground	No internal connection to die
6	NC	No Connect or Ground	No internal connection to die
PKG BASE	GND	Ground	Provides DC and RF ground for LNA, as well as thermal heat sink. Use multiple ground vias beneath the package for optimal RF and thermal performance

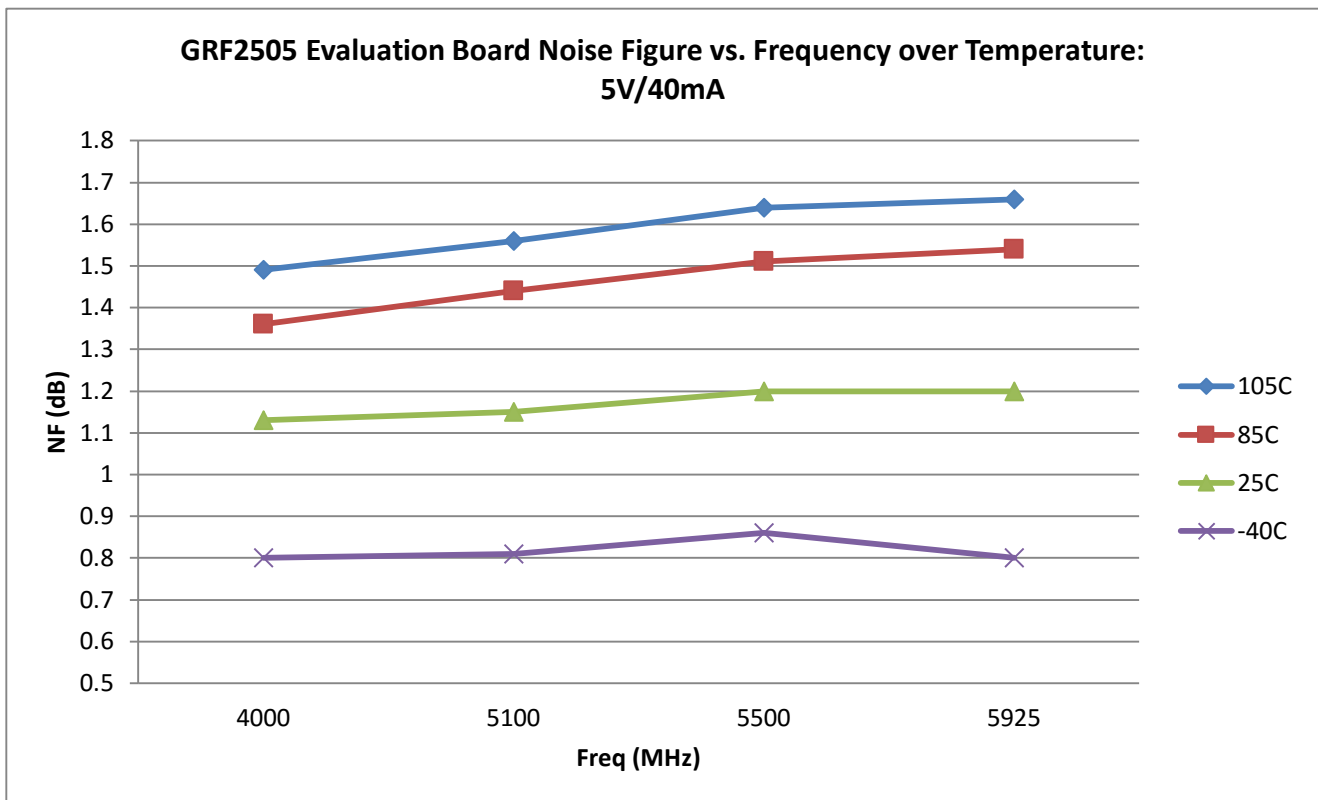
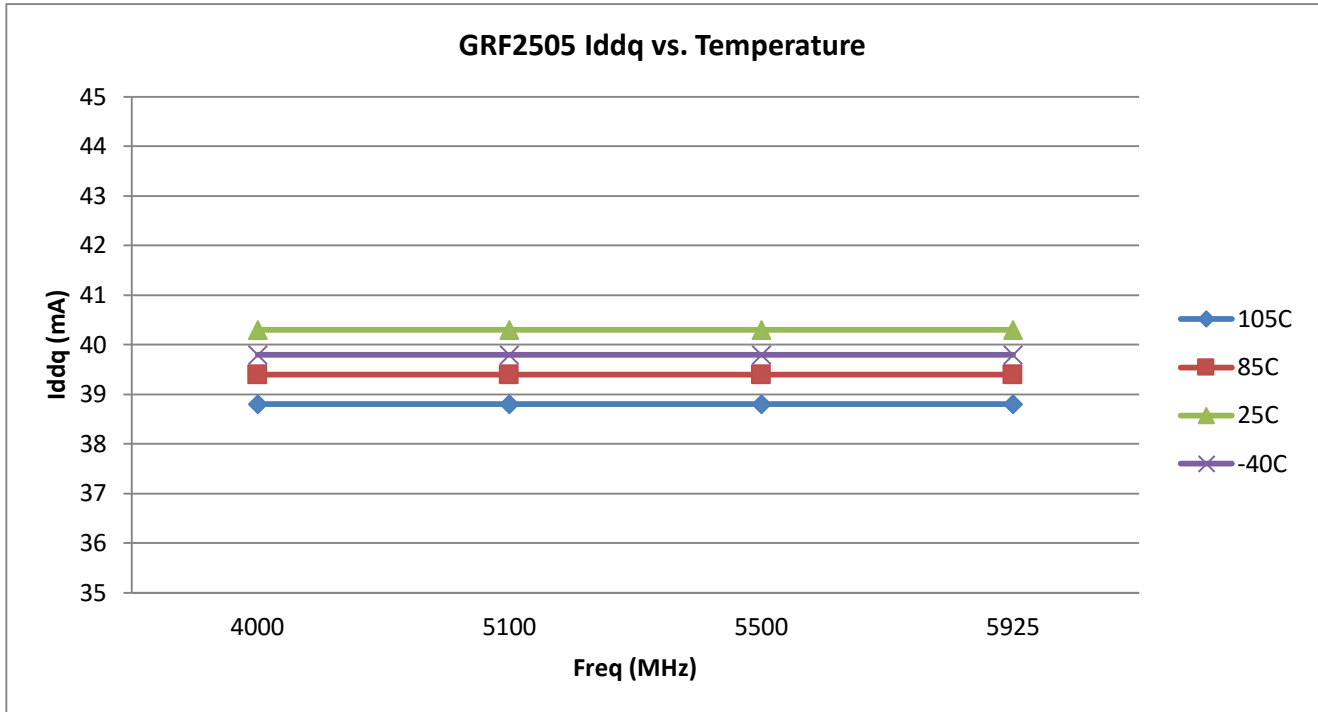
Nominal Operating Parameters:

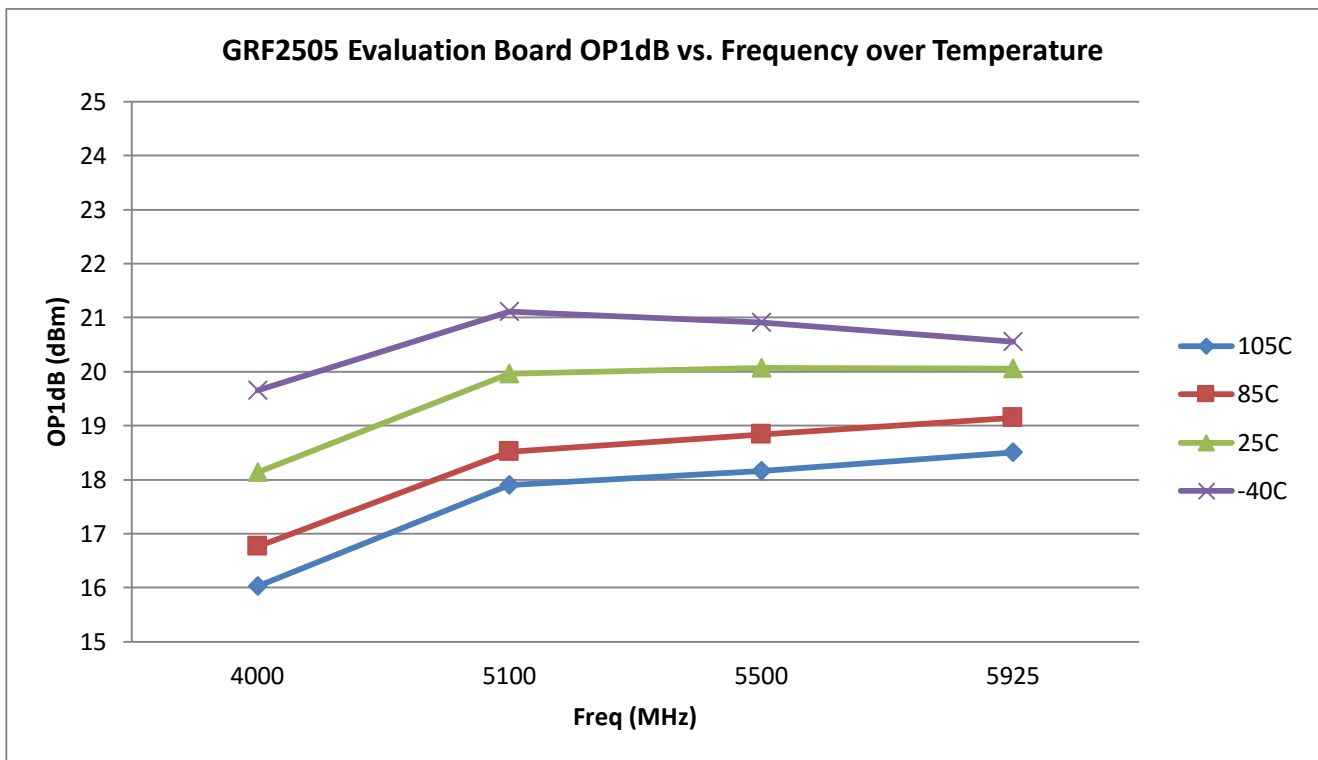
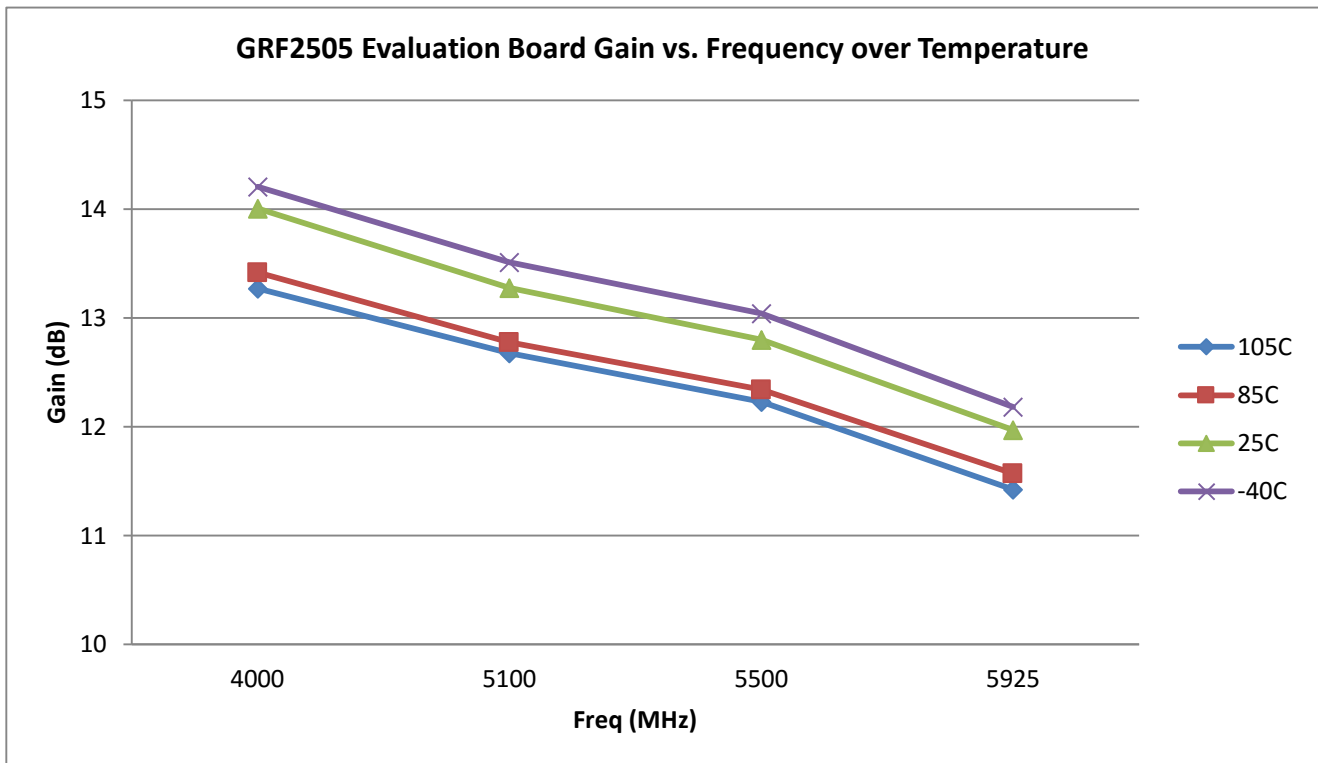
Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain Mode (Venable high)						Vd = 5.0 V, TA = 25 °C
Test Frequency	F _{TEST}		5.5		GHz	
Gain	S ₂₁		12.8		dB	
Input Return Loss	S ₁₁		-12		dB	
Output Return Loss	S ₂₂		-20		dB	
Noise Figure	NF		0.77		dB	Input trace losses de-embedded
Output 3rd Order Intercept	OIP3		+32.0		dBm	
Output 1dB Compression Power	OP1dB		+20.0		dBm	
Switching Rise Time	T _{RISE}		300		ns	No added capacitance on Venable line (M2 not needed)
Switching Fall Time	T _{FALL}		300		ns	No added capacitance on Venable line (M2 not needed)
Supply Current	I _{DD}		40		mA	Adjustable for optimal IP3
Thermal Data						
Thermal Resistance: (Infra-Red Scan)	Θ _{jc}		225		°C/W	On standard Evaluation Board
Channel Temperature @ +85 C Reference (Package heat sink)	T _{channel}		+141		°C	Vdd: 5.0 V; Iddq: 40 mA; No RF; P _{diss} : 200 mW

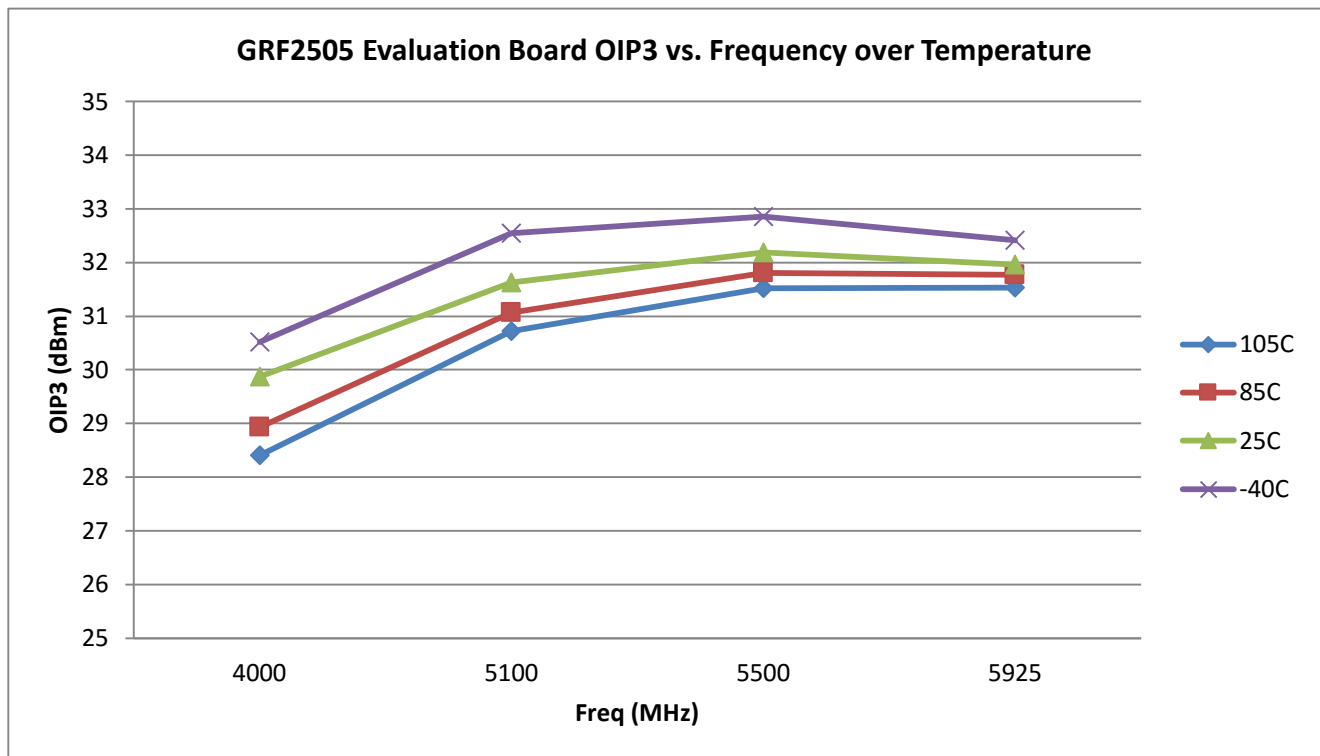




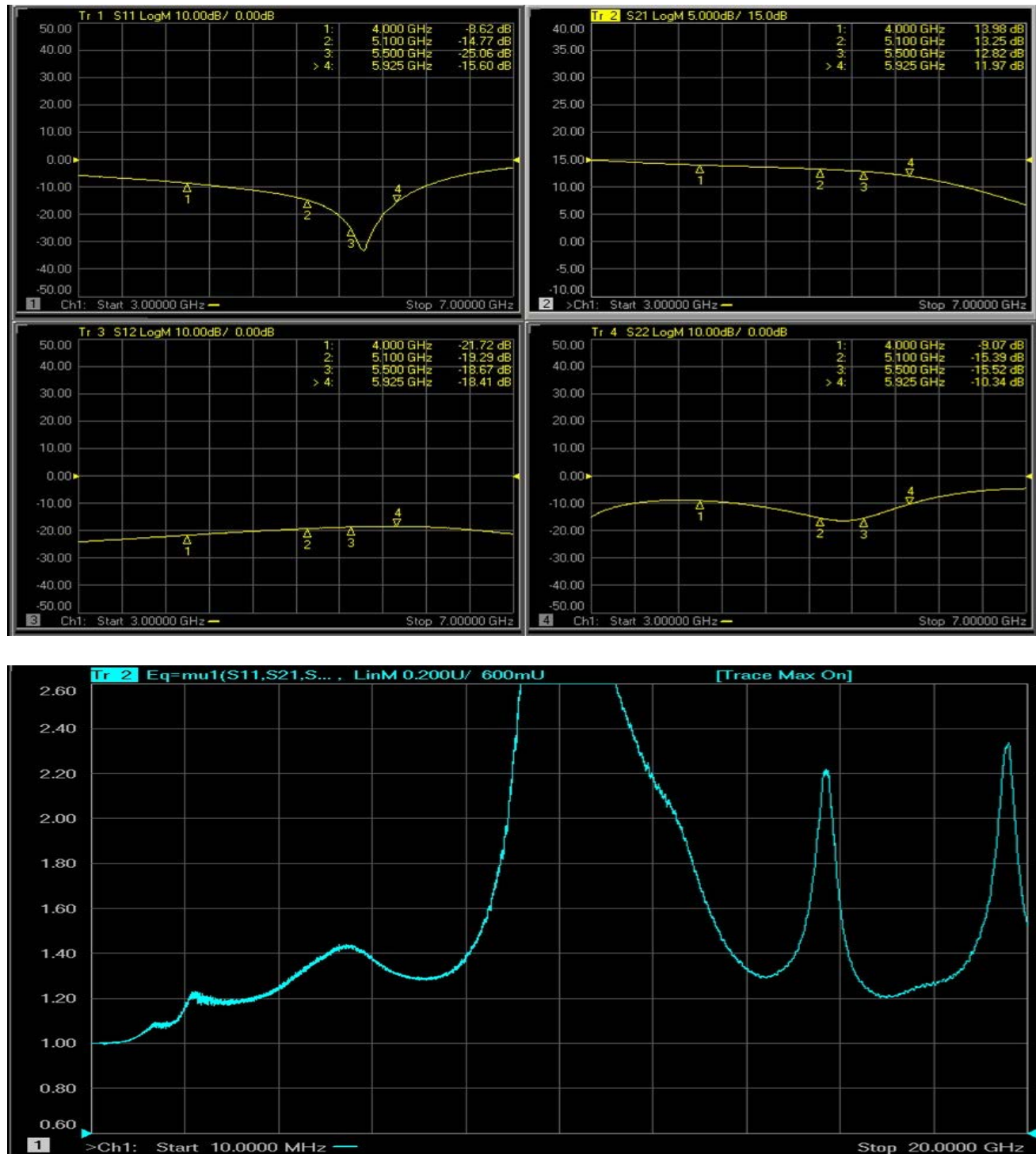
GRF2505 Performance over Temperature;







GRF2505 Evaluation Board S-Parameters and Stability Mu Factor:



Note: $\mu \geq 1.0$ implies unconditional stability

GRF2505 Theory of Operation:

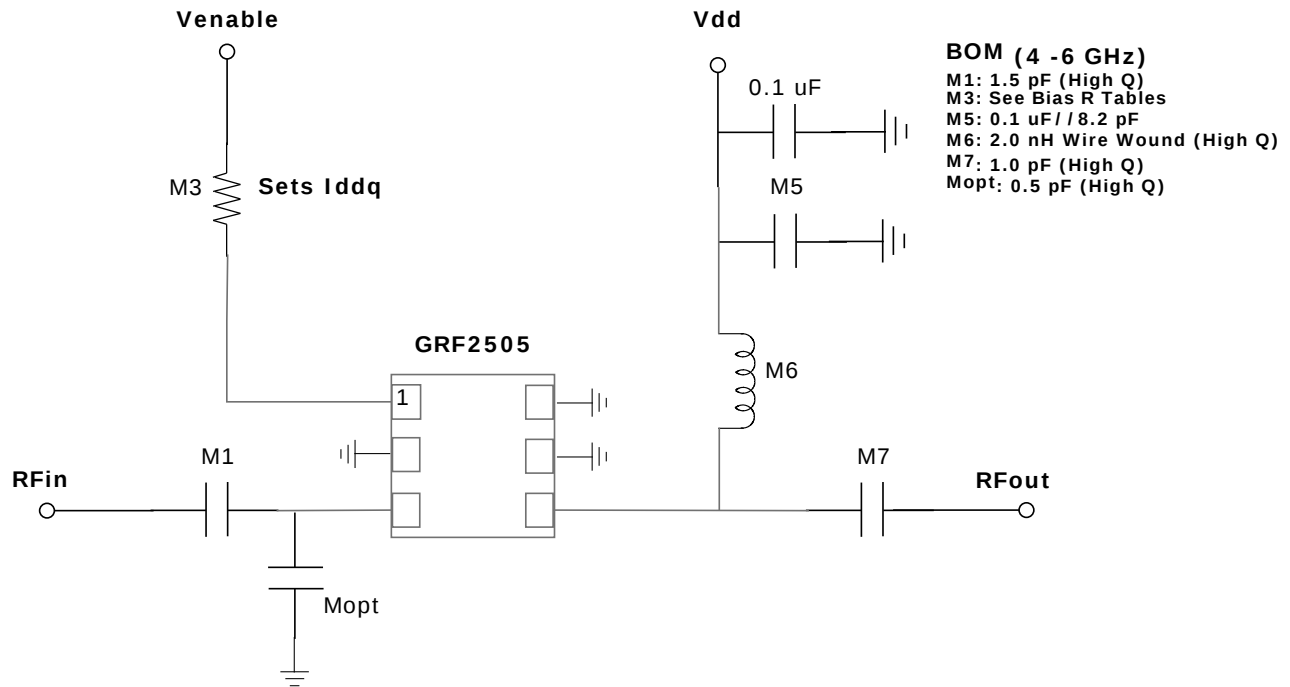
The GRF2505 is a single-stage, high-performance, low noise linear amplifier that is suitable for a wide range of applications. The device is internally matched to 50 ohms and covers 4 to 6 GHz with a single set of DC blocking caps (M1 and M7) and bias inductor (M6).

The device Iddq can be set independently from the Vdd via the resistor M3 in series with Venable. This allows the device to be optimized to meet a given linearity requirement with the highest possible efficiency. For a given Venable, increasing M3 will result in lower Iddq. As shown in the data sheet plots, GRF2505 exhibits excellent gain, NF and linearity over a wide range of Vdd values from 1.8 V up to 5.0 V.

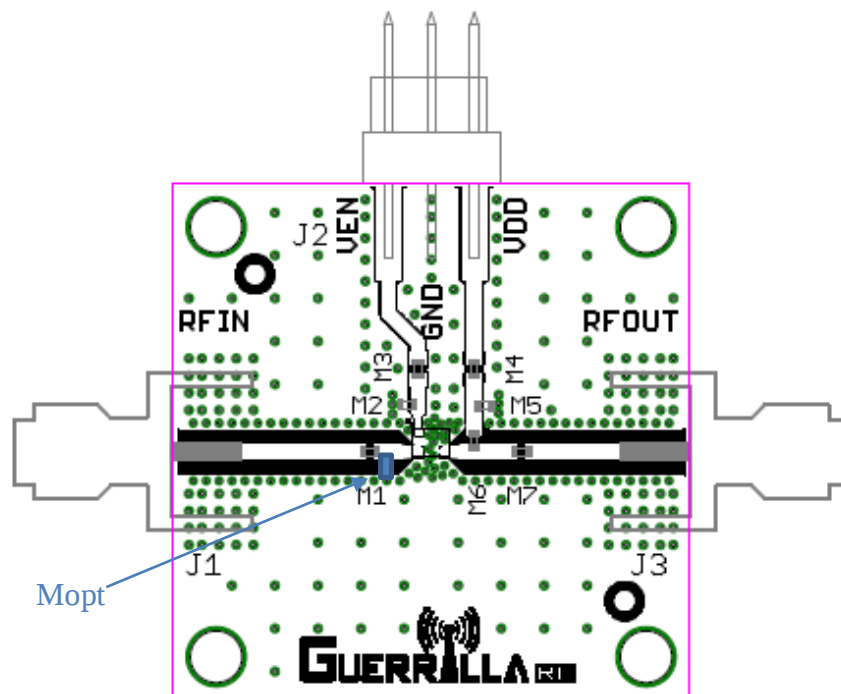
The tables on the following page show bias resistor values for a wide range of Venable and Vdd settings. The GRF Applications Team sees no performance benefit from Iddq values greater than 70 mA.

GRF2505 Bias Resistor vs. Iddq Table:

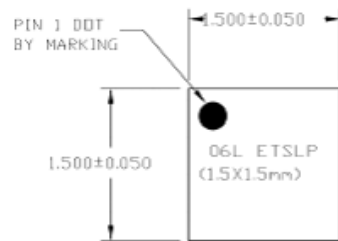
Device	Vdd	Venable	M3 (ohms)	Iddq (mA)	Device	Vdd	Venable	M3 (ohms)	Iddq (mA)	Device	Vdd	Venable	M3 (ohms)	Iddq (mA)
GRF2505	5.0	5.0	1500	55	GRF2505	4.5	4.5	1000	57	GRF2505	4.0	4.0	700	56
GRF2505	5.0	5.0	2000	48	GRF2505	4.5	4.5	1500	48	GRF2505	4.0	4.0	1000	49
GRF2505	5.0	5.0	3000	39	GRF2505	4.5	4.5	2000	42	GRF2505	4.0	4.0	1500	41
GRF2505	5.0	5.0	4000	34	GRF2505	4.5	4.5	3000	35	GRF2505	4.0	4.0	2000	36
GRF2505	5.0	5.0	5000	30	GRF2505	4.5	4.5	4000	29	GRF2505	4.0	4.0	3000	29
GRF2505	5.0	5.0	6000	27	GRF2505	4.5	4.5	5000	25	GRF2505	4.0	4.0	4000	25
GRF2505	5.0	5.0	7000	24	GRF2505	4.5	4.5	6000	23	GRF2505	4.0	4.0	5000	22
GRF2505	5.0	5.0	8000	22	GRF2505	4.5	4.5	7000	21	GRF2505	4.0	4.0	5500	20
GRF2505	5.0	5.0	10000	19	GRF2505	4.5	4.5	9000	17	GRF2505	4.0	4.0	6000	19
Device	Vdd	Venable	M3 (ohms)	Iddq (mA)	Device	Vdd	Venable	M3 (ohms)	Iddq (mA)	Device	Vdd	Venable	M3 (ohms)	Iddq (mA)
GRF2505	3.6	3.6	500	56	GRF2505	3.3	3.3	400	53	GRF2505	3.0	3.0	200	55
GRF2505	3.6	3.6	800	48	GRF2505	3.3	3.3	800	43	GRF2505	3.0	3.0	500	45
GRF2505	3.6	3.6	1000	44	GRF2505	3.3	3.3	1000	39	GRF2505	3.0	3.0	800	38
GRF2505	3.6	3.6	1500	37	GRF2505	3.3	3.3	1500	33	GRF2505	3.0	3.0	1000	35
GRF2505	3.6	3.6	2000	32	GRF2505	3.3	3.3	2000	29	GRF2505	3.0	3.0	1200	32
GRF2505	3.6	3.6	3000	25	GRF2505	3.3	3.3	2500	25	GRF2505	3.0	3.0	1500	29
GRF2505	3.6	3.6	4000	22	GRF2505	3.3	3.3	3000	23	GRF2505	3.0	3.0	2000	25
GRF2505	3.6	3.6	4500	20	GRF2505	3.3	3.3	3500	21	GRF2505	3.0	3.0	2500	22
GRF2505	3.6	3.6	5000	19	GRF2505	3.3	3.3	4000	19	GRF2505	3.0	3.0	3000	20
Device	Vdd	Venable	M3 (ohms)	Iddq (mA)										
GRF2505	1.8	1.8	0	35										
GRF2505	1.8	1.8	50	33										
GRF2505	1.8	1.8	100	32										
GRF2505	1.8	1.8	200	29										
GRF2505	1.8	1.8	300	27										
GRF2505	1.8	1.8	500	24										
GRF2505	1.8	1.8	700	21										
GRF2505	1.8	1.8	1000	20										
GRF2505	1.8	1.8	1200	18										



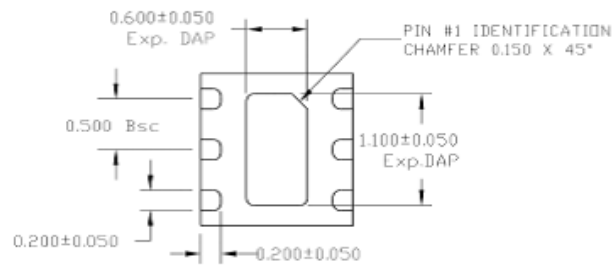
GRF2505 Evaluation Board Application Schematic



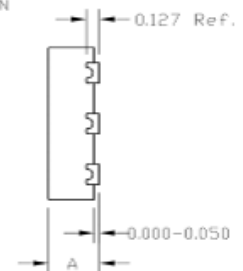
GRF2505 Evaluation Board Assembly Diagram



TOP VIEW



BOTTOM VIEW

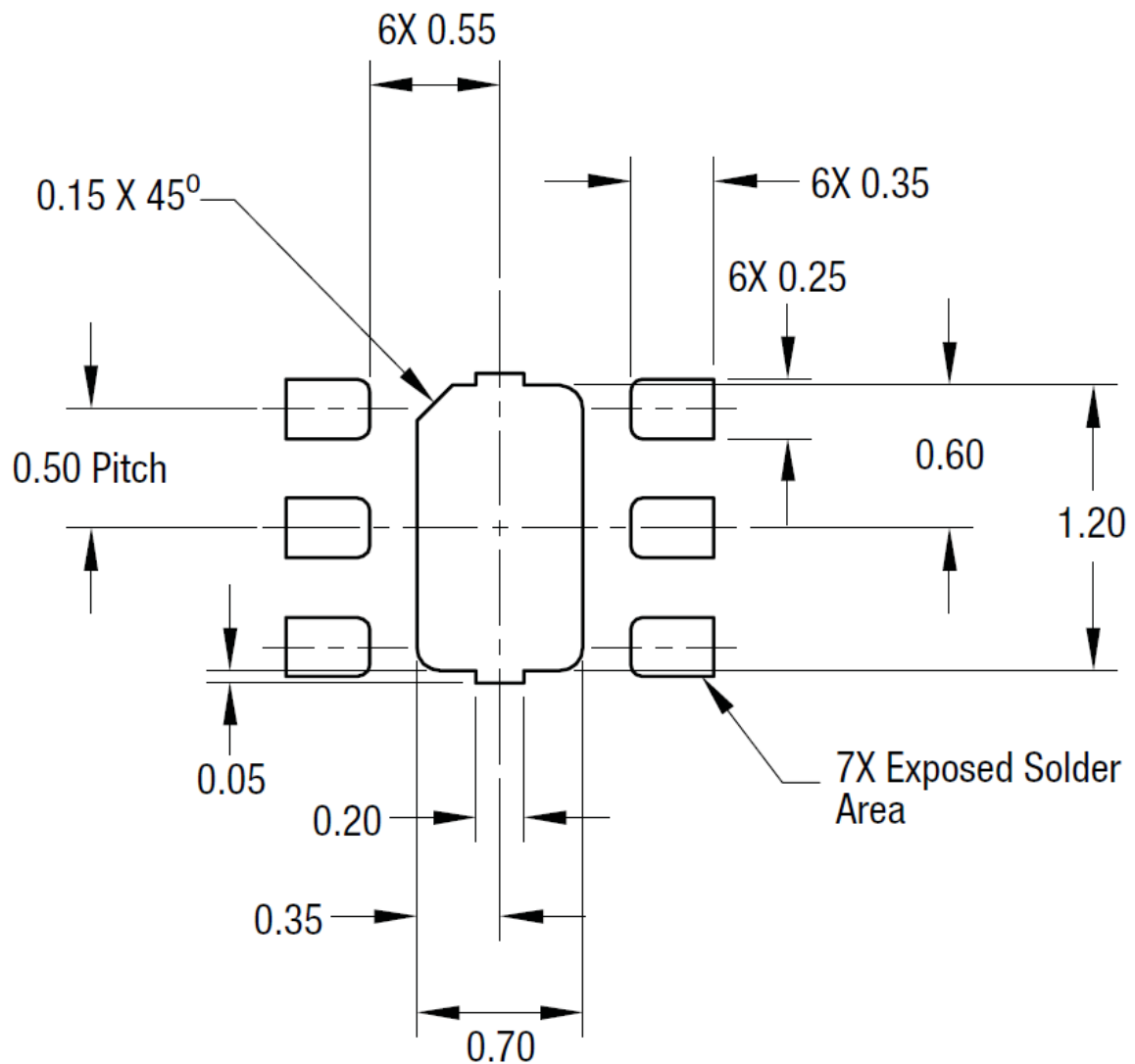


SIDE VIEW

		ETSLP
A	MAX.	0.500
	NOM.	0.450
	MIN.	0.400

				TOLERANCES REFER TO SPECIFICATION ABOVE	UNIT:	SCALE:	DATE:	
					MM	NTS	DATE:	
					SYMBOL		DATE:	
							DATE:	
DESCRIPTION	DATE	BY	APPD				REV: 00	06L (ETSLP) 1.5X1.5 mm (PACKAGE OUTLINE) SHEET NO: 1 OF 1

GRF2505 DFN-6 Package Dimensions



GRF2505 1.5 x 1.5mm 6-Pin DFN PCB Layout Footprint

Data Sheet Release Status:	Notes
Advance	S-parameter and NF data based on EM simulations for the fully packaged device using foundry supplied transistor s-parameters. Linearity estimates based on device size, bias condition and experience with related devices.
Preliminary	All data based on evaluation board measurements in the Guerrilla RF Applications Lab.
Released	All data based on device qualification data. Typically, this data is nearly identical to the data found in the preliminary version. Max and min values for key RF parameters are included.

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